NUCLEAR INDUSTRY STANDARD PROCESS

Radiological Protection

Level 3 – Information Use

Use and Control of HEPA Filtration and Vacuum Equipment

NISP-RP-008

Revision: 1
Industry Approval Date: October 30, 2018

This is an industry document for standardizing radiation protection processes. Standard processes and requirements are established to eliminate site-specific radiation protection procedures. The Institute for Nuclear Power Operations (INPO) maintains current procedures on the INPO website. Approval authority is granted by the industry contingent on a structured review and approval process by representatives of utility radiation protection organizations.

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1.0 Purpose

1.1 This procedure provides instructions for the selection, operation and monitoring of HEPA ventilation and vacuum equipment used for radiological protection.

2.0 Scope

2.1 This procedure does not apply to HEPA ventilation or vacuum units used for other industrial hazards such as lead/asbestos abatement. Documentation will be completed using site specific forms, electronic processes, or the attachments to this procedure.

2.2 The forms referenced by this procedure are examples used to describe the pertinent information that should be recorded for future reference. Plant procedures may specify the use of equivalent forms or the use of electronic media for the same purposes.

2.3 Member utilities are expected to use this standard to enable supplemental workers to transition between nuclear power plants. Compliance with these instructions is expected without additional site requirements or process deviations being imposed that may require additional training or challenge the performance of supplemental workers.

2.4 This procedure will be used to train and instruct supplemental radiological protection technicians. Member utilities will implement these process requirements in site procedures and update site procedures whenever requirements or process steps in this Nuclear Industry Standard Process (NISP) are revised. Current revisions are maintained on the INPO website.

3.0 Definitions

3.1 Terms, acronyms, and definitions are provided in NISP-RP-013, Radiation Protection Standard Glossary of Terms.

4.0 Responsibilities

4.1 Radiation Protection is responsible for the implementation of the requirements of this procedure per Efficiency Bulletin 17-01 and the Nuclear Industry Standard Process Initiative.

4.1.1 Providing technical support for type, size and use of HEPA units.

4.1.2 Perform filter change out on HEPA units

4.1.3 Inspecting HEPA units.

4.1.4 Issuing HEPA vacuums for use in Radiologically Controlled Areas (RCA).

4.1.5 Performing periodic surveys on vacuums in use.

4.2 Work Group Responsibilities

4.2.1 Notifying Radiation Protection when HEPA unit is required to be in/out of service to ensure the HEPA unit is monitored while in use.

4.2.2 Notifying Radiation Protection if the HEPA unit may have been damaged by bumping, jarring, or dropping during transport, setup, or use.

4.2.3 Notifying Radiation Protection if the HEPA filter is exposed to fire, paint fumes or other volatile chemicals during use.

4.2.4 Work group may be allowed to start/stop the HEPA unit per Radiation Protection direction.

5.0 General Requirements

5.1 Only HEPA and vacuum units with a current DOP/PAO test can be used to control airborne radioactivity.

5.2 HEPA and vacuum units shall be DOP/PAO tested based on the manufacturer recommendations but as a minimum will be tested once every 24 months or when HEPA filter media is changed. Date for retesting will be displayed on the unit.

5.3 Only HEPA certified vacuum units can be used inside the RCA.

5.4 Physical inspection is required for all HEPA and vacuum units prior to being placed in service. Specific attention is to be made to electrical connections and power cords, hoses and connections, equipment guards, and HEPA exhaust port guards. Do not operate any equipment with potential safety defects.

> NOTE: HEPA ventilation equipment could transport harmful vapors or fumes to other areas of the plant or the HEPA media could be damaged. Ensure a proper safety evaluation has been completed prior to using HEPA ventilation equipment when other industrial hazards are present.

5.5 All HEPA and vacuum units used inside the RCA must be tagged as internally contaminated and cannot be opened without Radiation Protection oversight. If the unit has been used in an alpha Level 3 area it must be indicated on the tag as possibly containing alpha contamination.

5.6 Contact Industrial Safety prior to using a HEPA ventilation unit any time that volatile substances, vapors or fumes are expected to be generated during the work activity.

5.7 Portable HEPA ventilation does NOT eliminate the requirements for air quality or confined space monitoring.

5.8 Only those vacuums labeled as wet vacuums, or wet/dry vacuums or systems designed for this purpose, shall be used to remove liquids.

5.9 HEPAs that require an operating voltage greater than 120V AC will require maintenance support for electrical connections. HEPA's requiring multi-phase wiring (e.g., 480V 3 phase) should have proper rotation checked prior to placing the unit into service

5.10 All HEPA units and vacuums used in the RCA, while not in use, will be controlled in a manner to prevent unauthorized removal and use.

5.11 When not in the use, the openings of the HEPA ventilation unit and hoses will be covered to prevent access to any potentially contaminated surface or component.

5.12 An Out of Service tag will be attached to any HEPA ventilation or vacuum unit removed from service due to equipment failure or retesting due date.

5.13 Radiation levels should be monitored on the HEPA units and vacuums while they are in service. Where available, and based on the potential for increase in radiation levels, telemetry units should be placed on the filter housing to provide a continuous method of monitoring.

5.14 Fire zone loading should be considered when installing HEPA equipment.

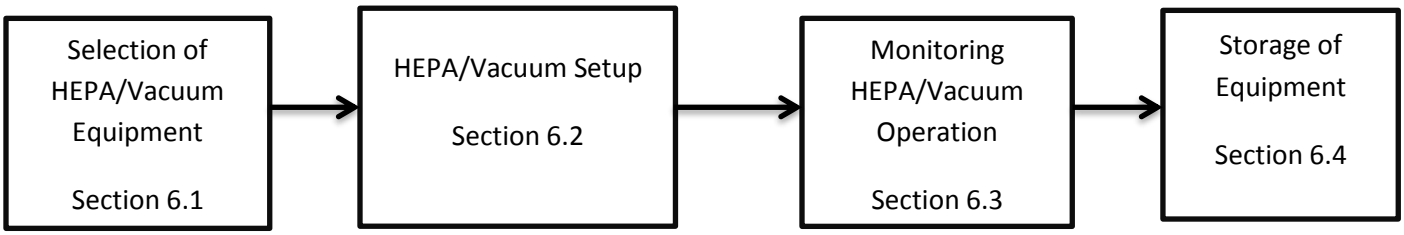
> NOTE: Due to the flow of oxygen a fire in a ventilation hose can spread rapidly. Ensure proper precautions are taken if spark producing work is taking place in the area.

5.15 Spark arrestors should be used on all HEPA units for work activities that generate sparks such as grinding on metal.

5.16 Do **NOT** operate HEPA units with the end of the suction hose covered as this will damage components, over heat the unit, and may result in fire.

5.17 Site guidance should be utilized for the removal and replacement of HEPA filters based on unit type and model available.

6.0 Process Instructions



6.1 Selection of HEPA and Vacuum equipment

6.1.1 The decision to use HEPA ventilation or vacuum equipment, and the type required, will be made based on the work activity and the expected radiological conditions and the implementing instructions will be included in the RWP or ALARA Plan.

6.1.2 Prior to determining the proper engineering controls, the potential airborne activity will be projected during the TEDE ALARA process. The potential airborne generation takes into consideration the work methods being used, plant ventilation systems, and environmental conditions (e.g. wet surfaces). Once the airborne generation rate has been projected the proper equipment can be selected.

6.1.3 Use Attachment 1, Capture Velocity Chart, for guidance, to determine the capture velocity needed based on the work activity. If the work activity has been completed successfully in the past then historical information can be used to determine the capture velocity requirements.

6.1.4 Use Attachment 2, Effective Capture Velocity and Distance Chart, for guidance, to determine the ventilation hose size requirements for the work activity.

6.1.5 Select the proper ventilation equipment by taking into consideration the following additional factors:

a. Weight loading of the equipment on floor or grating

b. Ability to position the hose at the required distance to provide proper capture velocity and allow the workers the visibility to perform the task.

c. Spark arrestors should be installed for all spark producing work activities. Consider the use of fire resistant hose material if available.

d. Consider the use of a noise suppressor on the discharge of the unit to facilitate a better work environment.

6.1.6 Select the proper vacuum unit depending on the following conditions

a. Wet or dry conditions are expected during the work process

b. Distance the material will have to be transported through the hose from the suction point to the receptacle.

c. Potential dose rates on the material being vacuumed

NOTE: At some sites the discharge of the HEPA units may be directed towards, or attached directly to, the plants containment purge or ventilation system. Ensure the equipment is installed according to site specific documents and tested as required prior to use

6.1.7 In applications where iodine is expected, charcoal filters should be considered/ utilized.

6.1.8 If a charcoal filter bank is being used take additional steps to monitor for iodine at the discharge of the unit. Several factors contribute to the charcoals ability to remove iodine including humidity which can change over the course of a work activity.

6.2 HEPA/Vacuum Setup

6.2.1 Verify the HEPA or vacuum unit DOP/PAO testing is current prior to setup in the field.

6.2.2 Verify the tamper proof seal or equivalent is in place on the unit.

6.2.3 Validate the current radiological conditions of the unit are indicated on the RAM label or tag.

6.2.4 Check the physical condition of the unit including the condition of the power cord. Do not plug into an electrical power source if the cord shows signs of damage.

6.2.5 Each HEPA and vacuum unit shall have a unique number and should be signed out to the work location using Attachment 3, HEPA/Vacuum Issue and Return Log, or electronic equivalent.

6.2.6 Use caution when removing end covers of hoses or HEPA units due to the potential for internal contamination. Proper contamination control measures should be implemented prior to removing the covers.

6.2.7 If the HEPA exhaust is in or near a contaminated area, take precautions to prevent the air flow from creating an airborne area by:

a. Directing exhaust to open air

b. Ensure structure or components in exhaust area are free of contamination

c. Direct exhaust to a non-contaminated area

6.2.8 Ensure the HEPA exhaust screen is intact which prevents personnel injury from rotating equipment.

6.2.9 Use the following guidance to route the ventilation hose

a. Minimize the amount of hose used to prevent the potential collapsing of the trunk. Keep the hose as straight as possible from the unit to the work site

b. Make sure the suction of the hose is located in the proper location to provide the capture velocity necessary to provide the proper ventilation

c. Minimize sharp bends or curves which can reduce the suction flow and prevent the desired CFM from being achieved. If sharp bends are necessary consider the use of fabricated joints.

d. Route hose in low traffic areas or in the overhead to prevent trip hazards to personnel. As appropriate use safety flagging to make personnel aware of the hazard.

e. If the hose is being routed vertically consider the need for hose supports based on the weight of the HEPA hose being used

6.2.10 If a charcoal filter is required install the device in the suction of the HEPA unit or per the manufacturer's instructions.

6.2.11 After inspection and installation of the HEPA hose, connect the unit to power source. If the unit uses greater than 120V AC the unit must be connected by a qualified individual.

6.2.12 Power up the unit and observe the magnehelic gauge, if equipped, and ensure it falls within the band established for that unit.

6.2.13 If the magnehelic gauge is outside the band then secure the unit and take the following actions

a. Validate the hose does not collapse while the unit is in operation.

b. Validate the magnehelic gauge connections are not loose

c. Validate the end of the hose is open and free

d. Validate there are no sharp bends in the hose which could reduce the air flow

e. If no issues where found, consider the need to replace the HEPA and/or Pre-filters using site guidance.

f. For units operating on 3 phase 220/480V AC it may be necessary to verify the rotation of the unit upon initial startup.

6.2.14 For operation of vacuum units individuals should review the requirements in Attachment 5, Worker Instructions for Vacuum Operation.

6.3 Monitoring HEPA/Vacuum Operations

6.3.1 Dose rate monitoring frequency for HEPA and vacuum units should be based on the potential for changing conditions. In most cases the units should be checked daily when in use or at a survey frequency determined by RP supervision. Survey frequency is documented on Attachment 4, HEPA Inspection Log.

6.3.2 Consider installing a telemetry device, if available, and there is the potential for the HEPA or vacuum unit to become a source of exposure. Install the monitoring device on the filter housing.

6.3.3 Use Attachment 4, HEPA Shift/Daily Inspection, to validate the operation of the unit once per Day/Shift or at the frequency determined by RP supervision while in operation.

6.3.4 The effectiveness of HEPA unit operation should be monitored based on the risk associated with failure of the unit. For high risk activities (i.e. Steam generators ventilation) consider the use of continuous air monitors to provide a quick indication of equipment failure. For other medium to low risk activities smear the discharge of the unit and/or obtain air samples to validate the unit's operation.

6.4 Storage of Equipment

6.4.1 HEPA and Vacuum equipment should be stored in a controlled manner to prevent unauthorized personnel from placing equipment in service.

6.4.2 RP personnel will maintain the control of HEPA and vacuum units by issuing equipment using Attachment 3, HEPA/Vacuum Issue/Return Log, or electronic equivalent.

6.4.3 Fire loading should be considered before storing HEPA ventilation equipment inside the plant.

6.4.4 HEPA and vacuum equipment shall be clearly tagged in accordance with NISP-RP-004, Radiological Posting and Labeling.

6.4.5 Charcoal filtration units should be stored to prevent damage from moisture based on manufacture's recommendations.

7.0 Records/Documentation

7.1 Retain copies of documentation generated as a result of implementing this procedure in accordance with the provisions of the station records management program requirements.

7.2 Computer generated equivalents may be used in place of the Attachments provided that, at a minimum, the information contained on the Attachment is contained on the equivalent.

8.0 References

8.1 Commitments

NONE

8.2 General

8.2.1 American Conference of Governmental Industrial Hygienists (ACGIH), Industrial Ventilation Manual, 1998.

8.2.2 OSHA 29CFR1910.212(a), Machine Guarding

8.2.3 Vendor Equipment Technical Information Manual (specific for make and model in use)

8.2.4 INPO 05-008, Radiological Protection at Nuclear Power Stations

8.2.5 NISP-RP-004, Radiological Posting and Labeling

8.2.6 NISP-RP-013, Radiological Protection Glossary

9.0 Attachments

9.1.1 Attachment 1 – Capture Velocity Chart

9.1.2 Attachment 2 – Effective Capture Velocity and Distance

9.1.3 Attachment 3 – HEPA/Vacuum Issue/ Return Log/ - Sample

9.1.4 Attachment 4 – HEPA # _____ Inspection Log – Sample

9.1.5 Attachment 5 – Worker Instructions for Vacuum Operation - Sample

Attachment 1
Capture Velocity Chart
Page 1 of 2

Dispersion of Contaminant	Examples	Typical Capture Velocity (FPM)
Release with practically no velocity into still air	• Evaporation from tanks • Work on "wet" components	50 – 100
Released at low velocity into moderately moving air	• Welding spray booths • Intermittent container transfer • Hand tool work on contaminated items	100 - 200
Active generation into rapidly moving air	Spray Painting, Barrel Filling	200 – 500
Released at high velocity into very rapidly moving air	Grinding, abrasive blasting	500 - 2000

Attachment 1
Capture Velocity Chart
Page 2 of 2

Velocity Flow Diagram

H. Flow Rates

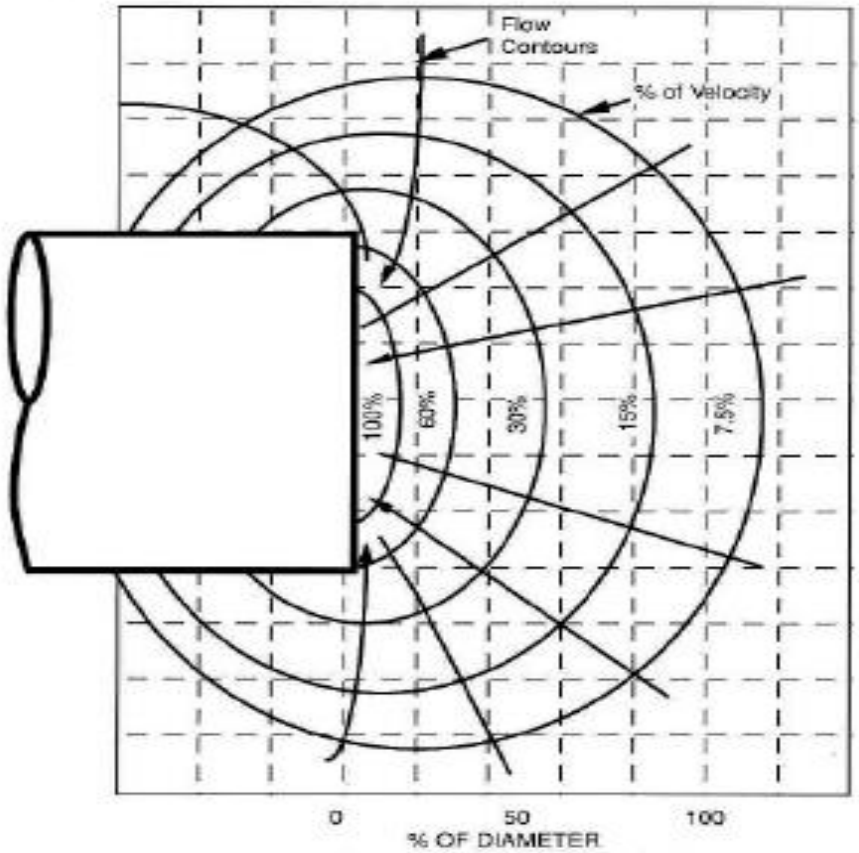


Figure **Velocity Contours - Plain Circular Hose Inlet Opening - % of Opening Velocity**

Source:
https://law.resource.org/pub/us/cfr/ibr/001/acgih.manual.1998.pdf

Attachment 2
Effective Capture Velocity and Distance
Page 1 of 3

Flow Rate In CFM	Capture Velocity in Feet per Minute (for 12" Hose)					
	@ Face	@ 3"	@ 6"	@ 9"	@ 12"	@ 15"
500	636	354	152	78	46	
600	764	425	183	94	56	
800	1019	567	244	125	75	
1000	1273	709	304	156	93	61
1200	1528	850	365	187	111	73
1400	1783	993	426	218	130	85
1600	2037	1134	487	250	148	97
1800	2292	1276	548	281	167	110
2000	2546	1417	608	312	185	122

Flow Rate In CFM	Capture Velocity in Feet per Minute (for 10" Hose)					
	@ Face	@ 3"	@ 6"	@ 9"	@ 12"	@ 15"
200	370	172	66			
400	740	343	132	65		
600	1110	515	197	98		
800	1480	686	263	130	76	
1000	1850	858	329	163	95	62
1200	2220	1030	395	195	114	74
1400	2590	1201	461	228	133	86
1600	2960	1373	526	260	152	98
1800	3330	1544	592	293	171	111
2000	3700	1716	658	325	190	123

Attachment 2
Effective Capture Velocity and Distance
Page 2 of 3

Flow Rate In CFM	Capture Velocity in Feet per Minute (for 8" Hose)					
	@ Face	@ 3"	@ 6"	@ 9"	@ 12"	@ 15"
375	1069	385	131	63		
500	1425	513	175	83	48	
625	1781	641	219	104	60	39
750	2138	769	263	125	72	47
875	2494	897	306	146	83	54
1000	2850	1025	350	167	95	62
1125	3206	1154	394	188	107	70
1250	3563	1282	438	208	119	78
1375	3919	1410	481	229	131	85
1500	4275	1538	525	250	143	93
1750	4988	1794	613	292	167	109
2000	5700	2051	700	333	191	124

Attachment 2
Effective Capture Velocity and Distance
Page 3 of 3

Flow Rate In CFM	Capture Velocity in Feet per Minute (for 6" Hose)					
	@ Face	@ 3"	@ 6"	@ 9"	@ 12"	@ 15"
85	442	104				
125	650	153	47			
200	1040	245	74	34		
300	1560	368	112	52		
400	2080	490	149	69	39	
500	2600	613	186	86	49	32
600	3120	736	223	103	59	38
700	3640	858	260	120	69	44
800	4160	981	298	138	78	50
900	4680	1103	335	155	88	57
1000	5200	1226	372	172	98	63

Attachment 3
HEPA/Vacuum Issue/Return Log – Sample
Page 1 of 1

HEPA/Vacuum Number	Location of Use	Date/Time	Placed By Print/Sign	Returned to Storage By Print/Sign	Date/Time	Dose Rate mR/hr	DOP/PAO Current
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No
							☐ Yes ☐ No

Attachment 4 –
HEPA#_____ Inspection Log – Sample
Page 1 of 1
Inspection Frequency Daily/Shiftly/Other_____
(Circle one of the above; if other specify the frequency)

Date/Time	Location	Smear results	Dose Rate	Magnehelic Reading	Physical Inspection	Performed By
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	
/					Sat / Unsat	

SRRS 2B.119

Attachment 5
Worker Instructions for Vacuum Operation – Sample
Page 1 of 1

1. If at any time you are uncertain about your responsibilities, place work in a safe condition and immediately contact RP for guidance.
2. Only use a vacuum unit that has been DOP/PAO tested within the last 24 months
3. Do **NOT** open a vacuum unit without contacting RP.
4. Do not use the vacuum for any other job or task than the one for which the vacuum was issued.
5. Do not use wet vacuums for dry work or dry vacuums for wet work
6. If a dry vacuum inadvertently collects liquids, **then** stop work, shut off unit and contact RP.
7. Ensure that the vacuum cleaner and associated equipment has a yellow radioactive material label or tag with dose rate information. If the tag is not attached, contact RP prior to use for surveying.
8. If you have reason to believe that dose rates or contamination levels on the vacuum cleaner or attachments have changed during use, then contact RP to perform a radiological survey and update the radioactive material label or tag
9. Verify the unit has a tamper proof seal or equivalent installed and is intact.
10. Cover the openings on the suction lines after use, or between uses, to prevent release of contamination.
11. Immediately discontinue the use of vacuum cleaner(s) that do not perform properly, have safety issues, or appear to be leaking or discharging at any location other than the normal discharge port.
12. If the vacuum becomes full and needs to be emptied, then contact RP
13. Return vacuum cleaner to issue station when no longer needed.